Evolution of MRI features of cerebral small vessel disease

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Valorisation.
Valorisation

“Valorisation is the process of creating value from knowledge, by making knowledge suitable and/or available for social and/or economic exploitation and to translate this knowledge into competitive products, services, processes and new commercial activities.” (adapted definition based on the National Valorisation Committee 2011:8). In other words, it is the important translation of scientific knowledge to social, financial and economical relevance.

Economic and social burden of cSVD

Stroke is one of the leading causes of long-term disability worldwide. In the Netherlands, approximately 41,000 people are yearly admitted to a hospital due to a stroke1. Further, the estimated number of patients who are living in the Netherlands with the consequences of a stroke is nearly 310,000 people1. The medical costs of stroke are substantial, accounting for 2.5% of the total medical costs in the Netherlands2. Therefore, stroke puts a major burden on the healthcare system and society in general. It is expected that these numbers will increase over the years, as the mean age of the population will rise and the incidence of stroke increases with age.

Lacunar stroke accounts for 25% of all ischemic strokes and is in general caused by cerebral small vessel disease (cSVD), which is an umbrella term for all pathologies affecting small vessels of the brain. Besides stroke, cSVD also causes cognitive impairment, dementia and gait disturbances. These consequences increase the social burden of cSVD far beyond the negative consequences of stroke.

The pathogenesis of cSVD is largely unknown and ways to slow down the progression of cSVD are still lacking. Comprehension of the natural course and progression of structural brain changes seen in cSVD, results in better understanding of both pathogenesis and consequences of cSVD, and eventually will lead to specific treatment and prevention options. This thesis aids in understanding the natural disease course of cSVD and shows that the radiological evolution of cSVD is a highly dynamic process with progression, stability, regression and disappearance of cSVD lesions. These findings implicate that some cSVD lesions might be reversible and imply that better vascular risk factor management could limit or even prevent progressive cSVD-related brain damage, which eventually could lead to a better clinical outcome. It is expected that total healthcare costs will decrease by preventing progressive cSVD-related brain damage.

Lacunar stroke

Lacunar stroke is generally thought to be a “minor” stroke. However, a sporadic symptomatic lacunar stroke should not be seen as an isolated “minor” clinical event. A lacunar stroke is just one of the several clinical expressions of an underlying small vessel vasculopathy with a progressive and highly dynamic course. The dynamics of cSVD seems to be more complex than we thought. A symptomatic lacunar infarct shows morphological
changes on the long term, but also shows that the surrounding brain tissue undergoes secondary neurodegenerative changes over time.

Valorisation of this scientific knowledge to clinical practice needs to be done. We have to assess the prognostic value of these secondary white matter changes on cognition, gait and general functional outcome. However, the most important start of knowledge valorisation is its publication. We made the knowledge of this thesis available for other researchers, (healthcare) organizations and the general public in multiple, scientific publications.

Total SVD burden score

As different MRI markers of cSVD often co-occur, it is thought that the presence of these MRI markers together, represents the severity of brain-related damage of cSVD. Earlier, our research group proposed the “total cSVD score”, which combines all individual MRI markers of cSVD into one measure. This total cSVD burden score is easily applicable in clinical practice as it is a visual rating scale of conventional MRI sequences and does not need computer software. Further, a total cSVD burden score gives a more comprehensive view of the overall impact of cSVD on the brain. This thesis includes the first longitudinal study to determine the possible association between total cSVD burden and gait impairment after minor stroke. The results of this study imply that the total MRI burden score could be used as a neuroimaging marker of “brain frailty”, which identifies stroke patients at risk for (subjective) gait impairment related to cSVD, independent of the incident stroke. Gait disturbances are common in the elderly and are related to functional disability, institutionalization, and death\(^5\).

Last years, the interest in this compound cSVD burden score has grown and other research groups have adopted the concept and also studied the predictive role of total cSVD score on clinical outcome measures. Recent studies showed that the total cSVD burden could predict mortality\(^5\), unfavourable functional outcome\(^6\) and worse quality of life after stroke\(^7\). Therefore, the evaluation of total cSVD burden could facilitate developing individual treatment and rehabilitation strategies in patients with cSVD, which eventually leads to a better functional outcome.

A similar concept for a compound cSVD progression score is needed. However, the development will be a challenge due to the dynamic nature of cSVD. As we showed, the natural evolution of cSVD is not just a simple disease progression.

Conclusion

This thesis helps neurologists and stroke clinicians to better understand the natural disease course of cSVD. It seems that cSVD is not an innocent, slowly progressive disease, but rather a highly dynamic, accumulating, and neurodegenerative neurological disorder.

By preventing progressive cSVD-related brain damage in the future, personalized treatment approaches will eventually improve clinical outcome, including gait function
and general functional independence. This will eventually unburden the healthcare system and society in the future.
References